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SEMI-ANNUAL PROGRESS REPORT NO. 21

November 1, 1983 to April 30, 1984

NASA Grant NGL 25-001-054

Submitted to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Office of Space and Terrestial Applications
Technology Transfer Division
Washington, D.C.

Submitted by

W. Frank Miller*
John Tingle
Linda H. Wright
Brice Tebbs

MISSISSIPPI STATE UNIVERSITY
P. O. Drawer FR
Mississippi State, MS 39762

May 1, 1984

*Director, The Mississippi Remote Sensing Center

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APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS

I. Introduction

The major purpose of the Remote Sensing Applications Program is to interact with units of local, state, and federal government and to utilize Landsat data to develop methodology and provide data which will be used in a fashion such that a concrete, specific action will be taken by the cooperating agency. The attainment of this goal is dependent upon identification of agency problems which are immediate in nature, and subject to at least partial solution through the use of remotely sensed data.

Other subsidiary objectives include the development of a trained staff from the faculty of Mississippi State University who are capable of attacking the varied problem presented by the respective state agencies; the training of students in various University academic courses at both the undergraduate and graduate levels; the dissemination of information and knowledge through workshops, seminars, and short courses; and the development of a center of expertise and an operational laboratory for training and assistance to cooperating agencies.

II. General Program Progress

The investigation of the effectiveness of Thornthwaite's Water Balance technique of hydroclimatological assessment for small area (watershed) studies was completed. The study determined that runoff in central Mississippi can be estimated to within 18% using the Thornthwaite method. A copy of the abstract published in the MAS 1984 Abstracts, Journal of the Mississippi Academy of Science is included as Appendix I of this report.

A report to the Mississippi Natural Heritage Program presenting a habitat model for a threatened species, the gopher tortoise, is included as Appendix II of this report. Since the time that this report was submitted to the Natural Heritage Program, Natural Heritage personnel have field checked portions of George County and have indicated plans to submit suggestions/requested changes in the habitat model to MRSC.

The user's manual for the TELEPRO program, which is used to analyze animal location/habitat use, has been completed. It is included as Appendix III of this report.

Determination of the extent of mean high tide in Mississippi Coastal Waters, a project referenced in Progress Report No. 20, has been temporarily deactivated due to the unavailability of funds from the Mississippi Secretary of State's office. Additional flights are tentatively planned for June-July 1984 if funds are available at that time.

The project references in Progress Report No. 20, relating to the feasibility of merging Seasat radar (SAR) data with Landsat (MSS) data for enhanced forest type discrimination, is progressing. An expanded discussion is presented in Section A.

MRSC is negotiating a contract with Gulf South Research Institute to map Mississippi River Bottomland Hardwood timber stands between the river levees from Cairo, Illinois, to Port Sulfur, Louisiana (Section B). A segment of the river mapping will be compared to classified Landsat D Thermatic Mapper (TM) to determine the feasibility of using TM data for this type mapping and updating.

A project has been undertaken with the Mississippi Cooperative Fish and Wildlife Research Unit to study coyotes in Sumter County, Alabama. MRSC is constructing a Geographic Information System (GIS) for this study (Section C). In addition, MRSC is cooperating with the U.S. Forest Service, Mississippi Department of Wildlife Conservation, and the Department of Wildlife and Fisheries (Mississippi State University) in studying wild turkeys using telemetry transmitters. This project is described in Section D.

As described in Progress Report No. 20, the Forestry Department has obtained a Data General MV-4000 minicomputer. The MV-4000 was delivered in April 1984; consequently, little has been accomplished in the area of software development or software transfer. During the next reporting period, major efforts will be made to consolidate modeling and GIS software into one software package on the MV-4000. This effort will include not only consolidation and conversion of software which previously executed on the Eclipse S/130, but also programs referenced in Progress Report No. 20 which detect areas within a given data set that have a great amount of spectral diversity and which model forest stands, viewed vertically and horizontally.

III. Project Progress Reports

A. SAR Enhancement of Landsat-3 Digital Data for Tropical Forest Habitat Inventory

Introduction

The Mississippi Remote Sensing Center (MRSC) entered into a cooperative study with the Southern Forest Experiment Station entitled "SAR Enhancement of Landsat-3 Digital Data for Tropical Forest Habitat Inventory." The study, an extension of a study completed in 1982, seeks to discriminate tropical forest types for two ecological life zones in western and central Puerto Rico using Landsat Multispectral Scanner (MSS) data.

Objectives

The objective of the current study is to determine if forest type discrimination in Puerto Rico can be improved by merging Seasat synthetic aperature radar (SAR) data with Landsat (MSS) data.

Present Status

Based on some inherent properties of SAR data, it is believed that the use of Seasat/SAR data in conjunction with Landsat/MSS data will improve classification results in Puerto Rico. One of these properties is the low depression angle (67°-73°) produced by Seasat radar. This low angle should reduce the shadow effect of rough terrain, thus aiding in addressing the problem of shadow in the MSS Puerto Rico classification. Another property of SAR is its long wavelengths. The longer wavelengths should effectively address the problem of haze since they are little affected by Raleigh and Mie Scattering.

NASA/ERL of NSTL Station, Mississippi, has registered the Seasat/SAR and MSS data sets to a common coordinate system, and has merged the two sets into one. MRSC is awaiting shipment of the MSS/SAR data from ERL.

Future Plans

The future plans for the project include the following:

(1) A classification will be performed on the combined data sets using the EOD-LARSYS maximum likelihood classifier.

(2) The results of the classification will be interpreted using the SAR data to "illuminate" shadowed areas. Also, the possibility of correlation between MSS and SAR data signatures in haze areas will be explored. If such a correlation emerges, the SAR signatures will be used to correct the MSS signatures in those areas covered by haze.

B. Land Cover Mapping for the Mississippi River Data Base

Introduction

In 1979 MRSC hosted a workshop at Mississippi State University which presented the concept of construction of a GIS for natural resources management applications. Personnel from Vicksburg District, Corps of Engineers participated in the workshop and from their participation arose the idea for a Mississippi River Data Base. This data base is to be used for the display of digitally stored terrain features in map format as well as the evaluation of the impact of cultural activities on the land resource in the study area. The data base will consist of a series of digitized maps, each depicting a different information level or terrain feature. These digitized maps will be stored in a computerized form which allows for the retrieval and display of single feature maps or an integrated map containing several terrain features in combinations selected by the user in a manner controlled by the user.

Gulf South Research Institute (GSRI) of Baton Rouge was awarded the contract for the data collection by the Corps. MRSC is negotiating to subcontract with GSRI to map forest cover types.

Objectives

The objective of this project is to produce land cover maps of the area between the Mississippi River levees from Cairo, Illinois, to Head of Passes (Port Sulfur), Louisiana. MRSC will perform land cover classification from 1:24,000 color infrared (CIR) imagery, supplemental high altitude CIR imagery for those portions of the River covered by National High Altitude Program (NHAP), and 1:10,000 panchromatic

photography. In addition, a portion of the floodplain will be classified/mapped by processing TM data with ELAS software package which MRSC soon should have installed on the Forestry Department's MV-4000. This aspect of the project will demonstrate whether or not it is feasible to use TM to map hardwood stands with the precision necessary for this project.

Present Status

At this time MRSC is negotiating with GSRI for the mapping contract.

Future Plans

With formal entry into the contract and delivery of aerial photographs, land cover mapping will begin. Mapping will be done onto mylar overlays on the photographs and transferred to relevant 1:20,000 Hydrologic Survey book (base maps for this project) overlays. Concurrently ground truth collection by MRSC will help ensure mapping accuracy. GSRI will digitize from the Hydrologic Survey overlays supplied by MRSC.

C. Development of a Geographic Information System (GIS) for Determination of Seasonal Habitat Preferences of Coyotes

Introduction

The coyote (*Canis latrans*) is thought to have begun its range expansion into Mississippi and Alabama within the past 25 years. The rate of population increase, as indicated by coyote harvests in these two states, has risen sharply. In response to this situation, the Mississippi Cooperative Fish and Wildlife Research Unit (Coop Unit) is conducting a study of the food habits, home range, and interspecific interactions of coyotes with grey and red foxes in eastern Mississippi and western Alabama. MRSC has been engaged by the Coop Unit to construct a GIS to assist in this study.

Objectives

The objective of this study is to prepare a GIS for 16,000 hectares in Sumter County, Alabama. Five levels of information, transportation, land cover, surface hydrology, terrain, and animal locations, are to be included in the GIS. TELEPRO software will be used to process animal location data for inclusion into the GIS.

Present Status

At this time, transportation and surface hydrology have been digitized and loaded into the data base. Land cover, mapped on National High Altitude Program (NHAP) CIR photography, are being transferred to 1:24,000 topographic maps prior to being digitized. Terrain, i.e., upland or alluvium with terraces, have not been processed through USGS topographic maps. Animal locations have not been processed through

TELEPRO (this step is the responsibility of the Coop Unit), nor loaded into the data base.

Future Plans

When the GIS is completed, that is when land cover and animal locations are loaded, it will be submitted to the Coop Unit as a magnetic tape along with a final report describing methodology and input entities.

D. Development of Geographic Information System (GIS) for Determination of Seasonal Habitat Preferences of Wild Turkeys

Introduction

The Mississippi Cooperative Wild Turkey Research Project (MCWTRP) was begun in 1983 to study wild turkey population dynamics, habitat diversity and seasonal habitat preferences. MRSC was invited to participate in this program. The area of study is the Tallahala Wildlife Management Area (TWMA) located on National Forest Land in Jasper County, Mississippi.

Objectives

The objective of the MRSC participation in this study is to update and maintain a GIS constructed by MRSC for a whitetail deer study on TWMA in the late 1970's. The number of levels of information to be included in the updated GIS have not been formalized, but they will include at least: surface hydrology, transportation, radio telemetry data for bird locations, and detailed land cover data (such as timber stand species composition, age and condition class; prescribed burning records; site index; and cultural practices).

Present Status

MCWTRP is compiling and evaluating data from the U.S. Forest Service regarding land cover/timber stand conditions. This information and radio telemetry data (processed by TELEPRO software) will be loaded to the GIS as soon as they become available to MRSC. At present 10 turkey hens have been tagged with radio transmitters; plans call for 50 hens to be tagged eventually.

Future Plans

When the GIS is completed it will be submitted to MCWTRP as a magnetic tape along with a report describing methodology and input entities.

E. Remote Sensing Analysis Support Systems

Objectives

As reported in Progress Report No. 20, transfer of software from Mississippi State University's Univac 1100/80, as well as software development, was postponed pending arrival of the Forestry Department's Data General MV-4000 minicomputer. The MV-4000 was not delivered until late April (1984), and it was not rendered operational until April 30.

Accomplishments and Current Status

The TELEPRO User's Manual referenced in this report has been made available to various users of the TELEPRO program. A copy of the manual is included as Appendix III.

A new technique has been developed to compute diversity and complexity indices for habitat suitability modeling. Using a rudimentary raster to polygonal algorithm, it is now possible to perform analyses on a stand by stand basis as well as a pixel by pixel basis. The technique also allows the calculation of a value for within-stand diversity using the original reflectance values of the pixels which comprise the stand. It is anticipated that the complexity and diversity indices will show a direct correlation to such site conditions as stand age and density.

Future Plans

The following tasks have been established as goals for completion during the next reportion period:

(1) Transfer all image processing and GIS maintenance and modeling software from the Univac computer to the Forestry Department's Data General MV-4000.

(2) Consolidate all GIS and modeling software into a single software package. The new image processing/database system which has been in the planning stage for almost six months will finally be implemented on the new MV-4000. Programming revisions for the new system will eliminate the distinction between database variables and saved images and achieve greater power and simplicity in a single-step procedure.

(3) Testing will continue on the diversity procedure in order to determine its merits in edge detection and texture analysis.

IV. List of Special Assistance Offered

Technical Assistance or Publications Supplied

Dr. Richard Kaminski, Department of Wildlife and Fisheries, MSU

Ms. Joan Embree, Graduate Student, Department of Architecture, MSU

Dr. George Hurst, Department of Wildlife and Fisheries, MSU

Mr. George Parsons, Architect, Starkville, MS

Department of Entomology, Mosquito Project, MSU

Department of Agricultural Economics, MSU

Mr. Jason Pigg, Sturgis Lumber Company, Sturgis, MS

Dr. Ernie Russell, Department of Geology, MSU

Mr. Richard Birdsey, U. S. Forest Service, Southern Forest Survey Unit, Starkville, MS

Mr. Steve Sader, NSTL/ERL, NSTL Station, MS

Dr. Victor Zitta, Department of Civil Engineering, MSU

Dr. Jess Muncy, Mississippi Cooperative Wildlife Research Unit, MSU

Mr. G. S. Warnhalts, Mexico City, Mexico

Dr. Ken Matthes, Department of Agricultural and Biological Engineering, MSU

Ms. Carey Norquist, Biological Sciences Graduate Student, MSU

Mr. Tim Young, University of Tennessee, Knoxville, TN

Mr. Mike Davis, Reaves and Sweeney Engineers, Memphis, TN

Dr. Douglas Richards, Department of Forestry, MSU

Demonstration and Educational Activities

Soil Conservation Service, Soil Scientist Workshop, Jackson, MS

Presentation to General Faculty of Mississippi State University, University Instructional Improvement Committee, MSU

APPENDIX I

Volume XXIX
Supplement

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1984 Abstracts

Journal
of the
Mississippi
Academy of Science

MODELING RUNOFF IN CENTRAL MISSISSIPPI: AN EVALUATION OF THE WATER BALANCE METHOD. John Tingle. Dept. of Forestry, MS State Univ., MS State, MS 39762

This study compares surplus water, calculated using the Thornthwaite climatic water balance technique, with measured runoff in the basins of the Pearl River and the Chunky River. Water balance models for the period 1951-80 were constructed for each basin. Average divisional temperatures and average precipitation derived from the Thiessen polygon weighting technique were used for the water balance analyses. The calculated surplus water component of the water balance was compared with U.S. Geological Survey measurements of runoff for the same period. The climatically modeled surplus was found to be 11 percent greater than measured runoff in the Chunky basin and 18 percent greater than runoff in the Pearl basin. In an attempt to have the climatic model more realistically estimate the actual runoff regimes, adjustments were made to the model's soil storage capacity, potential evapotranspiration and routing of surplus/runoff; none of these adjustments significantly improved the accuracy of the model's estimation. It is concluded that the disparity can be attributed, in part, to the amount of moisture from precipitation input to groundwater which is not considered as part of the water balance model.

APPENDIX II

SCHOOL OF FOREST RESOURCES • AGRICULTURAL AND FORESTRY EXPERIMENT STATION
MISSISSIPPI STATE UNIVERSITY

DEPARTMENT OF FORESTRY
P. O. DRAWER FR
MISSISSIPPI STATE, MISSISSIPPI 39762
PHONE (601) 325-2946

January 10, 1984

Ken Gordon, Director
Miss. Natural Heritage Program
111 N. Jefferson Street
Jackson, MS 39202

Dear Ken:

Enclosed is a summary report on the Gopher Tortoise study - just enough to get started with. One of the main things we learned was that the data base should be developed using State Plane Coordinates for the reference system. We could then better give you a more specific location for the "high probability" colony sites. The model weights were based on cross-tabulations between known sites and soils and vegetation in addition to proximity to "good" soils. The latter was necessary to account for misregistration and to account for occurrences on soils which were not digitized.

I hope to have a more complete report out in the near future. If you have any questions, please call.

Sincerely,

W. F. Miller, Director
Miss. Remote Sensing Center

WFM/sjd

Enclosure

GOPHER TORTOISE HABITAT

CrossTabs

Known Habitat from MNHP % rept. cells	Proximity to coarse loamy soils
61.4	in cells
86.0	within 1 cell
91.3	within 2 cells
98.3	within 3 cells
100.0	within 4 cells

Land Cover Class	Proximity to reported colony sites (as cells) 0	1	2	3	4
Inert	0	1	0	1	836
Sparse Hdwd.	2	11	12	6	19
Pasture, Ag, Inert	5	11	11	30	28
Pine/Hdwd Sparse	5	27	28	40	13
Hdwd Normal	2	5	9	12	13
Pasture, Inert wet	0	3	5	8	6
Sparse Pine	3	13	9	24	20
Dry Scrub	1	10	10	10	17
Pine/Hdwd, Normal	2	8	9	17	13
Pine Sparse, Burned/wet hdwd	0	3	6	13	7
Wet Scrub	1	5	0	7	6
Crops	0	1	1	1	0
Water	0	0	0	0	0
Pine, Normal	2	2	7	16	11
Water, Vegetation	0	0	0	0	0

Alaga Series

The Alaga series consists of somewhat excessively drained, strongly acid soils that formed in sandy material. The slope ranges from 0 to 20 percent.

In a representative profile the surface layer is dark grayish-brown loamy sand about 5 inches thick. Below this layer, to a depth of about 50 inches, is yellowish-brown loamy sand.

Representative profile of Alaga loamy sand, 0 to 5 percent slopes, in a large wooded area, 4 1/2 miles south of Lucedale and 1 1/2 miles west of Mississippi Highway 63, NW1/4 NE1/4 sec. 19, T. 2 S., R. 6 W.

A1--0 to 5 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; strongly acid; clear, smooth boundary.

C1--5 to 11 inches, yellowish-brown (10YR 5/4) loamy sand; single grain; very friable; strongly acid; clear, smooth boundary.

C2--11 to 50 inches, yellowish-brown (10YR 5/8) loamy sand; single grain; loose; strongly acid; gradual, smooth boundary.

C3--50 to 74 inches, very pale brown (10YR 7/3) sand; few, fine, distinct mottles of strong brown; single grain; loose; strongly acid; gradual, smooth boundary.

C4--74 to 85 inches, mottled yellow (10YR 7/8), white (10YR 8/2), and reddish-yellow (5YR 6/8) sand; single grain; loose; strongly acid.

The A1 horizon is grayish brown, dark grayish brown, or very dark grayish brown. The C1 and C2 horizons are yellowish brown, strong brown, or brownish yellow. The texture in these horizons is dominantly loamy sand or loamy fine sand. In some places, however, the C1 and C2 horizons contain thin strata of sand or fine sand. The content of silt and clay, at depths between 10 and 40 inches, ranges from 10 to 25 percent. The color of the lower part of the C horizon is very pale brown, brownish yellow, or strong brown mottled with white and shades of brown, red, gray, or yellow. The texture in the lower part of the C horizon ranges from sand to loamy fine sand.

Alaga soils are geographically associated with Eustis, Lakeland, and McLaurin soils. They are not so red below the surface layer as Eustis soils, and they lack a Bt horizon. They contain more silt and clay in the uppermost 50 inches than Lakeland soils. Alaga soils are coarser textured throughout than McLaurin soils.

Alaga loamy sand, 0 to 5 percent slopes (AgB).--This soil occurs on ridgetops. It has the profile described as representative of the series. Included in mapping were small areas of Eustis loamy sand and McLaurin sandy loam.

This soil is strongly acid. Permeability is rapid, and the available water capacity is low. Runoff is slow, and erosion is not a serious hazard.

Alaga loamy sand, 5 to 8 percent slopes (AgC).--This soil occurs on uplands. It has a surface layer of dark grayish-brown loamy sand about 4 inches thick. This layer is underlain by strong-brown to brownish-yellow loamy sand to a depth of more than 65 inches. Included in mapping were small areas of Eustis and Lakeland soils. Also included were small areas of yellowish-red sandy loam more than 40 inches deep.

This soil is strongly acid. Permeability is rapid, and the available water capacity is low. Runoff is slow to medium, and erosion is a hazard where water concentrates and the ground cover has been removed.

Alaga loamy sand, 8 to 12 percent slopes (AgD).--This soil occurs on uplands. It has a surface layer of dark grayish-brown loamy sand about 6 inches thick. This layer is underlain by brownish-yellow to yellowish-brown loamy sand. Included in mapping were small areas of Eustis soils and of soils that contain a layer of yellowish-red sandy clay loam.

This soil is strongly acid. Permeability is rapid, and the available water capacity is low. Runoff is medium. Erosion is a hazard where water concentrates and the ground cover has been removed.

Alaga loamy sand, terrace, 0 to 5 percent slopes (AlB).--This soil is adjacent to the river flood plains. The surface layer is dark grayish-brown loamy sand about 5 inches thick. Below this layer, to a depth of about 50 inches, is yellowish-brown to brownish-yellow loamy sand. This is underlain by sand mottled with shades of gray, white, yellow, and brown. In this soil the water table is nearer the surface than in Alaga loamy sand. Included in mapping this soil were small areas of Harleston, Basin, and Lakeland soils. In a few areas the texture of the surface layer is sand.

This soil is strongly acid. Permeability is rapid, but the available water capacity is low. Except during periods of prolonged drought, the water table fluctuates at levels where it can compensate for the low available water capacity. Runoff is slow, and erosion is not a serious hazard. The organic-matter content is low.

Alaga complex, 12 to 20 percent slopes (AmE).--This complex is on relatively short side slopes. The Alaga soil makes up about 46 percent of the acreage. About 21 percent is made up of soils that have a surface layer of loamy sand and are underlain by yellowish-red sandy loam at a depth of 40 to 60 inches. The rest of the complex consists mostly of McLaurin soils and a soil that has a layer of yellowish-red sandy loam beginning at a depth of 20 to 40 inches. The pattern and extent of the soils vary from one place to another; one or both of the major soils, however, and one or more of the minor soils occur in any given area.

The Alaga soil has a surface layer of dark grayish-brown loamy sand about 4 to 10 inches thick. Below this is yellowish-brown or brownish-yellow loamy sand. This soil is somewhat excessively drained and strongly acid. Permeability is rapid, and the available water capacity is low.

The other soils in the complex have a surface layer of loamy sand of varying thickness underlain by yellowish-red sandy loam. They are well drained and strongly acid. Permeability is rapid through the loamy sand but is moderate in the sandy loam. Runoff is medium.

Eustis Series

The Eustis series consists of somewhat excessively drained, strongly acid soils on uplands. These soils formed in sandy material. The slope ranges from 0 to 20 percent.

In a representative profile the surface layer is dark grayish-brown loamy sand 6 to 8 inches thick. This layer, to a depth of about 92 inches, is underlain by strong-brown to yellowish-red loamy sand. The underlying material is brownish-yellow sand.

Representative profile of Eustis loamy sand, 0 to 5 percent slopes, under a cover of pine trees, 0.2 mile south, 1.1 miles east, and 0.25 mile south of school. SE1/4 NW1/4 sec. 20, T. 1 S., R. 5 W.

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, medium structure; loose; many fine roots; strongly acid; clear, smooth boundary.

A&B--6 to 8 inches, dark grayish-brown (10YR 4/2) loamy sand; few, fine and medium, distinct mottles of yellowish brown; weak, medium, granular structure and weak, coarse, subangular blocky; friable; few fine and medium roots; strongly acid; gradual, wavy boundary.

B1t--8 to 15 inches, strong-brown (7.5YR 5/6) loamy sand; weak, medium, granular structure and weak, coarse, subangular blocky; friable; sand grains coated and bridged with clay; strongly acid; gradual, wavy boundary.

B21t--15 to 34 inches, yellowish-red (5YR 5/6) loamy sand; weak, coarse, subangular blocky structure; friable; few areas of stripped sand grains; sand grains coated and bridged with clay; strongly acid; gradual, wavy boundary.

B22t--34 to 92 inches, yellowish-red (5YR 5/8) loamy sand; weak, coarse, subangular blocky structure; friable; few areas of stripped sand grains; sand grains coated and bridged with clay; strongly acid; diffuse, irregular boundary.

C--92 to 100 inches +, brownish-yellow (10YR 6/8) sand; structureless; loose; strongly acid.

The A horizon is dark grayish brown, dark yellowish brown, brown, or yellowish brown. It ranges from 4 to 12 inches in thickness. The Bt horizon is reddish yellow, strong brown, or yellowish red. It ranges from loamy sand to loamy fine sand in texture. Clay and silt make up 10 to 25 percent of the uppermost 20 inches of the B horizon. The Bt horizon is more than 60 inches thick.

Eustis soils are geographically associated with Alaga, Lucedale, and McLaurin soils. They are redder below the surface layer than Alaga soils and have a Bt horizon. They are coarser textured and less reddish than Lucedale soils. They contain less clay in the uppermost 20 inches of the Bt horizon than McLaurin soils.

Eustis loamy sand, 0 to 5 percent slopes (EsB).--This soil is on broad ridgetops. It has the profile described as representative of the series. Included in mapping were small areas of McLaurin and Alaga soils.

This soil is strongly acid. The available water capacity is low. Permeability is rapid. Runoff is slow, and erosion is not a serious hazard. This soil can be cultivated soon after a rain without risk of crusting or clodding. Shallow-rooted plants are damaged by lack of moisture during periods of drought.

Eustis loamy sand, 5 to 12 percent slopes (EsD).--This soil is on uplands. The surface layer, about 9 inches thick, is dark grayish-brown to yellowish-brown loamy sand. This layer is underlain by strong-brown to yellowish-red loamy sand. Some areas are underlain by sand at a depth of less than 50 inches. Erosion has removed the surface layer and caused some rill gullying in a few places. Included in mapping were small areas of McLaurin and Alaga soils.

This soil is strongly acid. The available water capacity is low. Permeability is rapid, and runoff is slow to medium. If the ground cover is removed, erosion is a hazard.

Eustis loamy sand, 12 to 20 percent slopes (EsE).--This soil occurs on side slopes. The surface layer is dark grayish-brown to dark yellowish-brown loamy sand about 5 inches thick. This layer is underlain by reddish-yellow to yellowish-red loamy sand more than 60 inches thick. In a few areas erosion has removed the surface layer, and deep, narrow gullies have formed where water from road and field ditches, terraces, or other sources is concentrated. Included in mapping were small areas of Alaga and McLaurin soils. Also included were a few small areas where the surface layer is more than 20 inches thick.

This soil is strongly acid. The available water capacity is low. Permeability is rapid, and runoff is medium. If ground cover is removed or runoff is concentrated, erosion is a hazard. Nearly all of this soil is in woodland. Pine trees are suited.

Lakeland Series

The Lakeland series consists of excessively drained, very strongly acid soils that formed in sandy material. The slope ranges from 0 to 17 percent.

In a representative profile the surface layer is dark-gray loose sand about 3 inches thick. The subsurface layer is grayish-brown loose sand about 4 inches thick. This is underlain by mixed light-gray and yellow sand about 5 inches thick. Below this layer, to a depth of about 55 inches, is brownish-yellow to reddish-yellow sand. The underlying material is mottled reddish-yellow and pink sand.

Representative profile of Lakeland sand, 0 to 5 percent slopes, in a wooded area 1/2 mile south of Palestine Gardens and 3/4 mile south of the Greene County line, SE1/4 NE1/4 sec. 6, T. 1 S., R. 8 W.

A11--0 to 3 inches, dark-gray (10YR 4/1) sand; weak, fine, granular structure; loose; many fine roots and some partly decayed leaves and twigs; very strongly acid; clear, wavy boundary.

A12--3 to 9 inches, grayish-brown (10YR 5/2) sand; single grain; loose; few fine and medium roots; very strongly acid; gradual, wavy boundary.

C1--9 to 14 inches, mixed light-gray (10YR 7/2) and yellow (10YR 7/6) sand; single grain; loose; very strongly acid; gradual, wavy boundary.

C2--14 to 32 inches, brownish-yellow (10YR 6/6) sand; single grain; loose; few grayish-brown organic stains on sand grains; very strongly acid; gradual, wavy boundary.

C3--32 to 55 inches, reddish-yellow (7.5YR 7/6) sand; single grain; loose; few medium roots; very strongly acid; diffuse, wavy boundary.

C4--55 to 65 inches, mottled reddish-yellow (5YR 6/8) and pink (5YR 7/4) sand; single grain; loose; very strongly acid.

The A11 horizon is dark gray, grayish brown, or dark grayish brown. It ranges from 2 to 7 inches in thickness. The A12 horizon ranges from grayish brown to yellowish brown in color and from 2 to 6 inches in thickness. The C horizon ranges from yellowish brown to brownish yellow, yellow, very pale brown, or reddish yellow in color. The content of clay and silt is less than 10 percent in the upper 50 inches of the C horizon.

Lakeland soils are geographically associated with Alaga, Eustis, and McLaurin soils. They are coarser textured than Alaga soils and slightly coarser textured than Eustis soils. They are coarser textured than McLaurin soils, which have a clay content of 10 to 18 percent. They lack the yellowish-red Bt horizon of McLaurin and Eustis soils.

Lakeland sand, 0 to 5 percent slopes (LeB).--This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were small areas of Eustis and Alaga soils. Also included were a few small areas that contain loamy material at a depth of less than 70 inches.

This soil is very strongly acid. Permeability is rapid, and the available water capacity is low. Runoff is slow.

Lakeland sand, 5 to 17 percent slopes (LeE).--This soil occurs mostly on side slopes. The surface layer is very dark gray loose sand about 2 inches thick. Below this, to a depth of more than 70 inches, is yellowish-brown, yellow, and very pale brown loose sand. Included in mapping were small areas of Alaga, Eustis, and McLaurin soils. Also included were a few small areas that contain loamy material at a depth of less than 70 inches.

This soil is very strongly acid. Permeability is rapid, and the available water capacity is low. Runoff is slow.

SUITABILITY MODEL FORM

Suitability Model Name: GOPHER TORTOISE HABITAT
User: MISS. NATURAL HERITAGE
Data Base Name: GEORGE
Date: 1/5/84

Portion of Data Base to be Modeled: ALL

VARIABLE No./Name	SUBCLASS VARIABLES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	WEIGHT
#3 Soils	0	9	7	3	3	0	0	0	0	0	0	0	0	0	10
#6 Land Cover	0	3	6	5	9	3	1	6	9	5	6	1	2	0	10
#9 Prox. Soils	9	9	5	5	1	0	0	0	0	0	0	0	0	0	10
MODEL OUTPUT:	YELLOW = 9			1414 cells = 2828 ha											
	BLUE = 8			2987 cells = 5974 ha											

SUBCLASS VALUES may range from 0 to 9
WEIGHT is relative and may be any two digit integer for each variable
A zero value is for a SUBCLASS VALUE will reject a data base cell with that subclass

George County Database

Logical Structure

1 Hydrology

- 0 Unclassified
- 1 Primary Streams
- 2 Oxbows
- 3 Lakes
- 4 Secondary Streams

2 Transportation

- 0 Unclassified
- 1 Heavy Duty Roads
- 2 Medium Duty Roads
- 3 Light Duty Roads
- 4 Unimproved Dirt Roads

3 Soil Suitability Classes

- 1 AgB,EsB,LeB
- 2 AgC,LeE
- 3 AgD,EsD
- 4 AmE

4 Incorporated Cities

- 0 Unclassified
- 1 City Boundaries

5 Gopher Tortoise Colonies (areas)

- 0 Unclassified
- 1 Tortoise Colonies

6 Landcover

- 1 Inert
- 2 Hardwood Sparse
- 3 Pasture/Agriculture/Inert Dry
- 4 Mixed Pine-Hardwood Sparse
- 5 Hardwood Normal
- 6 Pasture/Inert Wet
- 7 Pine Sparse
- 8 Scrub(Dry)
- 9 Mixed Pine-Hardwood Normal
- 10 Pine Sparse Burned/Wet Hardwood
- 11 Scrub Wet
- 12 Crops
- 13 Water
- 14 Pine Normal
- 15 Water with Vegetation

7 Known Gopher Tortoise Locations (points)

- 0 Unclassified
- 1 Location

8 Proximity to Gopher Tortoise Locations (points)

0 Location in cell

1 1 Cell Away From Location

2 2 Cells Away From Location

3 3 Cells Away From Location

4 4 Cells Away From Location

5 5 Or More Cells Away From Location

9 Proximity to Soils

0 Soil in Cell

1 1 Cell Away From Soil

2 2 Cells Away From Soil

3 3 Cells Away From Soil

4 4 Cells Away From Soil

5 5 Or More Cells Away From Soil

APPENDIX III

INTRODUCTION

The TELEPRO system is a series of computer programs developed at the Mississippi Remote Sensing Center (MRSC). These programs reside on the Univac 1100/80 and are intended for analysis of wildlife movements data. The system was designed to support radio-telemetry studies where field efforts were used to locate individual animals wearing radio transmitter collars.

There are several different operations that may be performed within the TELEPRO system. Each function is described in the following pages with a section giving some necessary background information on the function, and a Sample Session, showing actual statements needed to execute the function.

The TELEPRO system is designed to be used in conjunction with a geographic information system (referred to as a data base) that has been created using MRSC procedures.

INITIALIZATION PROCESS

I. Carter*Telepro.Init

A. Discussion

In this phase the user must enter information that is specific to his particular study area. This includes the number of base stations being used and also the coordinates in inches of the base stations as measured from the origin of the data base on the base map of the study area. The number of stations must be the same as the highest sequence number recorded as a station identifier in the raw field data. For instance, if your study area included a total of 18 base stations but data was only taken from station #1, #2, #8, and #18; then you would still enter the number of base stations as 18. You must then also enter coordinates for 18 stations. For any station that has no raw data associated with it, it is required to enter 0.0,0.0 as the coordinates for that station.

Further inputs in the initialization process include WARN, SMETER, MAGNETIC DECLINATION, and MINIMUM AZIMUTH DIFFERENCE.

WARN is a user-stipulated maximum distance between two consecutive triangulated animal locations. When this distance is exceeded, a message will be output to the user, but no action will be taken to exclude the points from computations. This is merely intended as a warning. The user inputs the value to be used as WARN. Therefore, getting a warning message output will depend on what formula the user used to arrive at his WARN value. The following distance will not cause a message to be output if that distance was not used in inputting WARN. A suggested formula for computing a WARN value would be:

[((Number of inches on the map on one side of a data base cell) x 75)].

SMETER is the number of meters on the ground represented by one inch on the base map.

MAGNETIC DECLINATION is the amount by which the magnetic needle of the compass is off the true meridian in the study area. When entering a positive magnetic declination, <u>do</u> <u>not</u> enter the + sign before the number. Negative numbers must include the - sign, however.

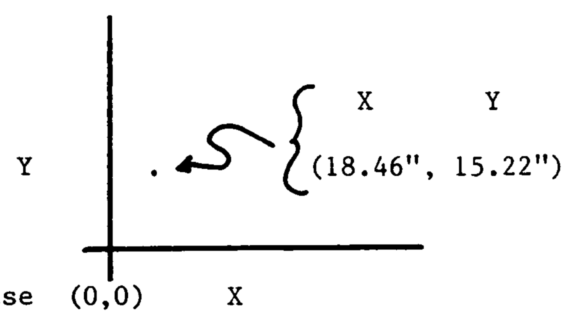
MINIMUM AZIMUTH DIFFERENCE is a user-stipulated minimum allowable difference between the two azimuth readings for any given fix. When the difference is found to be less than the stipulation, a warning message will be output to the user. However, no action is taken to disregard the fix. A typical minimum azimuth difference is 7.0.

The third portion of the initialization process is to enter X,Y coordinates of control points. These are the same control points that were used in the creation of the data base habitat features. Five points are required and each point is entered in two different units of measurement. The first unit is data base cells which is calculated based on the cell size of the data base and the scale of the base map. The second unit is inches as measured from the data base origin on the base map. Example:

Assuming:

1 hectare cell size for database

1:24000 scale base map



Origin of database

1 hectare = 10,000 sq. meters = 100 meters on side of a cell

1 meter = 39.37 inches Therefore, there are 3937 inches on 1 side of a cell.

On a 1:24000 scale map, 18.46 measured inches = 443,040 inches on the ground.

443040 ÷ 3937 = 112.53 data base X coordinate.

Therefore, for Xdatabase1 you would enter 112.53 and for Xinches1 you would enter 18.46. The coordinates are given to the program in the following manner:

```
Xdatabase1,Xdb2,Xdb3,Xdb4,Xdb5,Xinches1,Xin2,Xin3,Xin4,Xin5
Ydatabase1,Ydb2,Ydb3,Ydb4,Ydb5,Yinches1,Yin2,Yin3,Yin4,Yin5
```

B. Sample Session

(User inputs are underlined. Machine responses are indented and machine prompts are indicated by ?).

IMPORTANT NOTE: Each user of TELEPRO must have a unique projectID.
@RUN JANE,RST001V,DOE (Sample RUN statement; projectID is DOE)

? @XQT CARTER*TELEPRO.INIT

ENTER THE NUMBER OF BASE STATIONS

? 5

ENTER THE BASE STATION COORDINATES, ONE PAIR AT A TIME

? 26.68,13.95

ENTER THE BASE STATION COORDINATES, ONE PAIR AT A TIME

? 28.57,15.45

ENTER THE BASE STATION COORDINATES, ONE PAIR AT A TIME

? 26.75,15.95

ENTER THE BASE STATION COORDINATES, ONE PAIR AT A TIME

? 23.92,15.47

ENTER THE BASE STATION COORDINATES, ONE PAIR AT A TIME

? 23.94,14.04

END OF BASE STATION COORDINATE INPUT

ENTER VALUES FOR WARN, SMETER, MAGNETIC DECLINATION, MINIMUM AZIMUTH DIFFERENCE

WARN IS A USER-STIPULATED MAXIMUM DISTANCE BETWEEN TWO CONSECUTIVE ANIMAL LOCATIONS. WHEN THIS DISTANCE IS EXCEEDED, A MESSAGE IS OUTPUT TO THE USER BUT NO ACTION IS TAKEN. SUGGESTED FORMULA FOR WARN:

(NUMBER OF INCHES ON ONE SIDE OF A DATABASE CELL ON THE BASE MAP * 75)

SMETER IS NUMBER OF METERS REPRESENTED BY ONE INCH ON THE BASE MAP

? 12.303,609.6,4.5,7.0

ENTER DATA BASE CONTROL POINTS IN THE FOLLOWING MANNER. . .

```
XDB1,XDB2,XDB3,XDB4,XDB5,XIN1,XIN2,XIN3,XIN4,XIN5
YDB1,YDB2,YDB3,YDB4,YDB5,YIN1,YIN2,YIN3,YIN4,YIN5

(DB = DATABASE, IN = INCHES ON MAP)

? 112.53,144.01,181.93,193.21,223.84,18.46,23.62,29.84,31.70,36.72

? 92.75,45.40,73.87,52.86,74.90,15.22,7.45,12.12,8.67,12.29

INITIALIZATION ROUTINE COMPLETED
```

NOTE: If this portion (PART I) of the initialization procedure is repeated for any reason, two statements must be executed before the @XQT CARTER*TELEPRO.INIT.

They are:

```
@DELETE STACOORD.
@DELETE CTRLPTS.
```

II. Carter*Telepro.Read1

The raw telemetry data that is collected in the field is normally hand-written onto coding sheets and then keypunched onto 80-column cards. Before the TELEPRO system can access the data, the data must reside in a computer disk file. The procedure for transferring the data from cards to a disk file is as follows:

(Sample @RUN)

```
@RUN JANE,RST001V,DOE
@ASG,UP RAWCRIT.
@DATA,IL RAWCRIT.

        data cards

@END
```

The preceding statements should be typed on cards, inserting the data cards at the appropriate position. Note that the raw data file must be named RAWCRIT. If your data already exists on disk in a different file, then copy the data from your file into RAWCRIT before attempting to proceed with TELEPRO.

After the raw data has been placed in the disk file, execute the following statement to reformat the data file.

```
@XQT CARTER*TELEPRO.READ1
```

The program will prompt you to @ADD the RAWCRIT file. You then type

```
@ADD RAWCRIT.
```

After receiving the message "OUTPUT FILE (8) MUST BE SORTED INTO FILE (9)", type the statement

```
@ADD CARTER*TELEPRO.SORTDATA
```

to sort the data file. If this portion (PART II) of the initialization procedure is repeated for any reason, the following three statements must be executed <u>before</u> the @XQT CARTER*TELEPRO.READ1 is repeated:

```
@DELETE REFCRIT.
@DELETE SRTCRIT.
@DELETE OUTZAP.
```

If all information is input correctly, the entire initialization (PARTS I & II) need only take place once for any given study area.

GENERATION OF HOME RANGE STATISTICS AND ANIMAL LOCATION COORDINATES
Carter*Telepro.Trian

A. Discussion

This portion of the TELEPRO system takes the azimuth readings from two stations from the raw data set and triangulates to produce specific animal locations within the study area. The user will be prompted within the program as to whether he wishes to produce point or line location data. A selection of point data, as the name indicates, writes only the computed location points into the output file and dictates that any future mapping of the data will display only points. If line data is selected, the points will be connected and future mapping will produce a pattern of travel for the animal. TELEPRO.TRIAN does not produce any visual displays of the location data. The data is simply stored in a computer disk file for subsequent operations.

A second function of TELEPRO.TRIAN is to produce statistics on the home range of the animal during specified intervals. The user is prompted for the animal number and the dates and times for which he wishes to do analysis. The dates are specified as month, day, year (2 numerical digits each) and times are specified on a 24-hour clock basis (4 numerical digits 0001-2400). Various statistics are printed out such as: home range area in meters computed by three separate methods (refer to sample session); circumference of the area of use; minimum, maximum, and total distance traveled. Note that these statistics and also the location data generated will only pertain to the time interval specified.

B. Sample Session

(User inputs are underlined. Machine responses are indented and machine prompts are indicated by ?.)

```
? @XQT CARTER*TELEPRO.TRIAN

                    ***RADIO TELEMETRY TRIANGULATION ROUTINE***

    ***ENTER ANIMAL NUMBER, START-DATE(MO,DAY,YR), START-TIME(2400),
       END-DATE, END-TIME

? 130,10,01,82,0001,11,30,82,2400

    ***DO YOU WANT AREA STATISTICS? (1 = YES, 0 = NO)

? 1

    ***DO YOU WISH TO CREATE POINT OR LINE DATA?
       ENTER A (1) FOR POINT, ENTER A (0) FOR LINE

? 1

    ***ANIMAL 130 ***DATES 10 29 82 *TO* 11 9 82 **FIXES 26

    THE ABOVE ANIMAL SELECTION CREATED 26 ANIMAL LOCATIONS FROM YOUR
    DATA FILE

    AREA OF USE EQUALS                         HECTARES
         CONVEX POLYGON METHOD =               149.626
         CAPTURE RADIUS METHOD =               455.992
         NON-CIRCULAR METHOD =                 304.699

    GEOMETRIC CENTER FOR THIS AREA IS LOCATED AT    26.40,    13.50

    CIRCUMFERENCE OF THE AREA OF USE EQUALS     5486.460 METERS

    DIVERSITY INDEX FOR THIS AREA OF USE EQUALS     1.27

    MEAN ACTIVITY RADIUS =          .92

    STATISTICS FOR TRAVEL DISTANCE BETWEEN LOCATIONS IS AS FOLLOWS
    (UNIT = METERS)

                                               STATISTIC

         SAMPLE SIZE                               25.00
         MEAN                                     371.51
         VARIANCE                              212749.22
         STD. DEV.                                461.25
         MAXIMUM                                 2003.41
         MINIMUM                                     .00
         TOTAL DISTANCE                          9287.70
```

TIME STATISTICS FOR TRAVEL DISTANCE (UNITS = METERS AND DAYS)

	TIME STATISTICS
TOTAL TIME	12.00
MEAN	95.09
VARIANCE	53617.85
STD. DEV.	231.56
MAXIMUM	2003.41
MINIMUM	.00

**END OF RUN. DATA FILE (8) CONTAINS COORDINATES
**OF ANIMAL POSITIONS DURING INTERVALS SPECIFIED.

UPDATING OF THE GEOGRAPHIC DATABASE WITH THE LOCATION DATA

A. Discussion

As previously stated, TELEPRO.TRIAN generates a file of point or line location data in addition to a tabular summary of home range statistics. In order to perform any type of habitat analysis on a particular animal, the location data for that animal must first be included as a separate layer of information in the existing geographic data base. The data base concerns a specific geographic area (your study area) and will probably already contain several separate layers of information about that area — such as roads, hydrology, land cover, etc. These layers of information are referred to as variables of the data base.

Normally two separate "copies" or cycles of the entire data base are kept on the disk. One is the current version and the other is a backup. When inputting the location data into the data base, the current version of the data base should be specified as the first field on the @CARTER*TELEPRO.UPDATE statement, and the backup version should be specified as the second field (refer to Sample Session). After the update has been performed, the backup copy becomes the new current version, and the old current version becomes the new backup. For example, if NOXUBEE is the current version and NOXUBEE2 is the backup, the update would be as follows:

```
@CARTER*TELEPRO.UPDATE NOXUBEE.,NOXUBEE2.
```

The roles of the two versions of the data base will continue to reverse for each subsequent update.

Referring to the session following, the # DB VARS INCLUDING UPDATE will be one greater than the number of variables that already exist in the data base. This will increase each time you perform an update. The data type will always be 0 indicating digitized data.

A helpful scheme for keeping up with the current cycle of the data base and the current number of variables in the data base is as follows:

NOXUBEE	16		18		
NOXUBEE2		17		19	

Each time an update is performed, you record the current number of variables in a slot beside the current cycle name. If another update were to be performed using the example chart above, the update statement would read

@CARTER*TELEPRO.UPDATE NOXUBEE2.,NOXUBEE.

The number of variables including the update would be 20. A 20 would then be placed in the chart across from NOXUBEE.

Note in the sample session that the statement @CARTER*TELEPRO.COORDS must be executed before the update. The RMS ERROR should always be less than 1 in order to be acceptable. The response to SORT FILE (Y/N)? should always be Y if you intend to follow with an update. CARTER*TELEPRO.DUPS gives you a listing of coordinates that were repeated when the animal fixes were generated from the azimuth readings (CARTER*TELEPRO.TRIAN). The table provides the X,Y coordinate and the number of times the animal was located at that coordinate. This information could be useful in weighting preferred land cover types.

It should be apparent to the user that when an update is performed, the information that gets put into the data base as the next data base variable will be the location data from the last execution of CARTER*TELEPRO.TRIAN.

B. <u>Sample Session</u>

(User inputs are underlined. Machine responses are indented and machine prompts are indicated by ?.)

```
? @CARTER*TELEPRO.COORDS

    RMS ERROR = 2.4043-002

    NORMAL TERMINATION--OUTPUT IN PIXEL FILE 15.

    SORT FILE (Y/N)?

? Y

    ***SORT/MERGE SUMMARY***

    OPERATION = SORT
    INPUT STATISTICS:
         26 RECORDS IN     0 SKIPPED     0 REJECTED
         33 WORDS/RECORD ON INPUT
         26 RECORDS SORTED
    OUTPUT STATISTICS:
         26 RECORDS OUT     0 DELETED ON OUTPUT
         33 WORDS/RECORD ON OUTPUT
         224 WORDS/BLOCK ON OUTPUT

? @CARTER*TELEPRO.DUPS
```

COORDINATE	# OF OCCURRENCES
(157,85)	2
(163,85)	2
(160,81)	2
(156,80)	2
(162,80)	3
(164,75)	3

```
? @CARTER*TELEPRO.UPDATE NOXUBEE.,NOXUBEE2.

    ***ENTER # DB VARS INCLUDING UPDATE, DATA TYPE:  (0-DIG.:1-CORR)

? 10,0

    ***INPUT-DB HAS 9 VARIABLES AND 6 BITS/VAR.

    ***END RUN*** 18 PIXELS UPDATED OF 26 SORTED
```

MAPPING VARIABLES IN THE DATABASE

A. Discussion

Once a variable has been added to the database, a character-map representation of that variable may be generated on the Univac 1100/80. It is possible to generate a map of a single variable or to generate a map consisting of a combination of two variables. The latter is referred to as an "overlay" of one variable onto another variable. A probable application of an overlay for a user of TELEPRO would be to overlay the locational data (point or line) for a given animal onto the land cover variable. This overlay would enable the user to see the animal locations in relation to the different land cover types.

Referring to the Sample Session (Single Variable Map) following, the first argument specified on the @CARTER*TELEPRO.MAPIT statement should be the current cycle of the data base. The second argument is a file name supplied by the user. As stated in the example, the file will be created if it does not already exist. The file will be used to store the created map until it is printed. Note: Any map file name supplied by the user should not be used more than once in any given day, as this will cause problems for the system. The data base you are using is either a 4-bit or a 6-bit data base (designated at the time of creation). It is a 6-bit data base if any of the variables have more than 16 subclasses and a 4-bit data base otherwise. Following is an example listing of a data base variable with its associated subclasses.

(variable)	TRANSPORTATION	
	0	Void
(subclasses)	1	Paved
	2	Gravel
	3	Jeep Trails

If your data base is a 6-bit database, but the specific variable you wish to map has only 16 subclasses or less, you have the option of using the 64 greylevel character set or using the 16 greylevel character set for the map. It makes no difference which you use, except that the 16 greylevels seem to produce a more aesthetically pleasing map due to the set of symbols used. Note, however, if you are mapping a variable with more than 16 subclasses, you must use the 64 greylevel character set. Relating this discussion to the Sample Session (Single Variable Map), you would respond "Y" to the prompt "WOULD YOU LIKE THE 6-BIT CHARACTER SET?" to get 64 greylevels and "N" to get 16 greylevels. The DESCRIPTIVE TITLE is an identifier that will be printed on the map for the benefit of the user (can be up to 76 characters long). The response to VARIABLE TO MAP should be the sequence number of the variable within the data base. The DATABASE COORDINATES refer to the length and width in cells of the data base. The coordinates are given in the form X,Y,X,Y where Y is descending from north to south of the data base and X is ascending from east to west. There are several allowable responses to the prompt "SYM MAP?" besides "Y". (Y automatically sends the map to the printer at the main site. It also exits you from the map processor.) Alternate responses are outlined below:

D - This deletes the map from disk memory and exits you from the map processor.

E - This places the user in the system editor in read-only-mode. The editor can be useful in determining if the map looks the way the user wishes it to look. Note: Before using the E response, the user should be certain that he is familiar with the system editor commands so that he can view the map file and exit the map file properly.

H - This generates a histogram for the mapped area. A histogram is simply a table listing the subclasses within the map file and also how many cells fall into each subclass. After the histogram is printed, the prompt "SYM MAP?" will be repeated.

N - This will simply save the map file on the disk and then exit you from the map processor.

A response of "A" to "SYM MAP?" will print the above list of allowable responses for you and then repeat the prompt "SYM MAP?".

The remainder of this discussion will pertain to the Sample Session (Overlay Map). Note that in the example given, the "O" and "S" options are specified on the processor call statement(@CARTER*TELEPRO.MAPIT,OS). The "O" option is required to indicate that an overlay is being done. The "S" is optional. If included, the "S" indicates that the user wishes to specify a special character set to be used in producing the map. If the "S" is not included, the character set used for the map will default to either the usual 16 greylevel set or to the usual 64 greylevel set, depending upon which of the two the user indicates is appropriate. The response to ENTER VAR TO MAP should be the "base" variable of the two variables being used to produce the overlay. The OVERLAY VARIABLE # will be the sequence number of the variable that contains the point or line data to be overlaid onto the "base" variable. The user should be aware that the variable designated as the "overlay variable" will take precedence over a "base variable" for any given print position. For example, if land cover is specified as the overlay variable and an animal location variable is used as the base variable, land cover, and not the animal location will appear on the printed map. In the particular case of overlaying animal location data onto a base variable (probably land cover), the OVERLAY TYPE, # OF SUBCLASSES, SUB-CLASS #'S, OVERLAY GROUP # should always be 0,1,1,1. If the "S" option has been specified on the processor call statement, the query DO "YOU WANT TO CREATE A 6-BIT CHARACTER SET?" will be printed. A response

of "Y" will allow you to create a 64 greylevel character set and a response of "N" will allow you to create a 16 greylevel character set. In creating a 64 greylevel character set, the query "ENTER NEW CHARACTER SET: 1 LINE OF CHARACTER" will be printed. The user should respond with 64 single letters, numbers, and symbols that he wishes to be used for the map. The 64 characters entered will correspond to the 64 subclasses (0-63) allowed in a 6-bit data base. In the example given, 0's in the data base will be printed as blank spaces (0's should always be printed as spaces), 1's will be 1's, 2's will be 2's, 10's will be A's, 11's will be B's, etc. As in the case shown, it is acceptable to enter blanks for subclasses that do not exist in the variable. Noxubee land cover is being mapped in the example. It contains only 15 subclasses (as listed below) so it was only necessary to specify 15 numbers and letters.

Noxubee Land Cover

0 Unclassified
1 Pasture
2 Row Crops
3 Residential/Commercial
4 Cypress/Tupelo
5 Inert/Bare Soil
6 Open Water
7 Brush/Old Field
8 Void
9 Pine (Young)
10 Pine (Mature)
11 Pine/Hardwood (Young)
12 Hardwood (Young)
13 Hardwood (Mature)
14 Pine/Hardwood (Mature)

Note the "T" that is specified in position 63. The "T" will be printed for the animal location. When doing overlays, the characters to be printed for the overlay variable subclasses are specified starting in position 63 (position 64 is reserved) and counting backwards. In this example case the overlay variable had only 1 subclass (animal location variables created with TELEPRO will always have only 1 subclass), but if there had been second and third subclasses, the print character for the

second subclass would have been specified in position 62 and the print character for the third subclass in position 61. It should be evident that in mapping overlays the combination of the number of subclasses in the base variable and the number of subclasses in the overlay variable cannot exceed 63 when using a 6-bit character set. When using a 4-bit character set, the combination of the two cannot exceed 15.

Referring again to the Sample Session (Overlay Map), if you had responded "N" to the query "DO YOU WANT TO CREATE A 6-BIT CHARACTER SET?", you would then have received the response "ENTER NEW CHARACTER SET: 3 LINES OF OVERPRINTS". By entering "N" to the original query, you have indicated to the system that you wish to create a 4-bit character set. 4-bit character sets are created by specifying 16 (corresponding to subclasses 0-15) letters, numbers, and/or symbols at three different times. You should type in one set of 16 characters, hit the RETURN key (or whatever key your particular terminal uses to send information), type in a second set of 16 characters, hit the RETURN key, and type in a third set of 16 characters followed by the RETURN key. These three lines of characters will be used in combination to form the characters that are printed on the map. The technique used is referred to as overprinting. The three characters that have been specified in position 1 will be printed one on top of the other to form the map-character used for subclass 0. The three characters in position 2 will be printed one on top of the other to form the map-character used for subclass 1. The three characters in position 3 will be used for the map-character for subclass 2, and so on up through subclass 15.

Describing all of the capabilities and options of the map processor would be too extensive for the scope of this manual. If further information is needed on this subject, please contact the personnel at MRSC.

B. Sample Session (Single Variable Map)

(User inputs are underlined. Machine responses are indented and machine prompts are indicated by ?.)

? @CARTER*TELEPRO.MAPIT NOXUBEE., NMAP.

FILE NMAP DOES NOT EXIST. DO YOU WISH TO CREATE IT?

? Y

YOU HAVE SPECIFIED A 6-BIT DATABASE: WOULD YOU LIKE THE 6-BIT CHARACTER SET?

? Y

O.K., ALL PARAMETERS HAVE BEEN SWITCHED.

ENTER VAR TO MAP, DATABASE COORDINATES OF NORTHWEST AND SOUTHEAST CORNERS.

? 1,0,259,439,0

SYM MAP? (ENTER "A" FOR ASSISTANCE)

? Y

MAP HAS BEEN SENT TO MAIN SITE: ENJOY THE WALK!

Sample Session (Overlay Map)

```
? @CARTER*TELEPRO.MAPIT,OS   NOXUBEE.,NMAP.

    FILE NMAP DOES NOT EXIST.  DO YOU WISH TO CREATE IT?

? Y

    ENTER DESCRIPTIVE TITLE.

? COYOTE #620 ON LANDCOVER

    ENTER VAR TO MAP, DATABASE COORDINATES OF NORTHWEST AND SOUTHEAST
    CORNERS.

? 1,0,259,439,0

    ENTER OVERLAY VARIABLE #.

? 4

    ENTER OVERLAY TYPE, # OF SUB-CLASSES, SUB-CLASS #'s, OVERLAY GROUP
    #.

? 1,1,1,1

    YOU HAVE SPECIFIED A 6-BIT DATABASE:

    DO YOU WANT TO CREATE A 6-BIT CHARACTER SET?

? Y

    ENTER NEW CHARACTER SET:  1 LINE OF CHARACTER.

?  123456789ABCDE                                                   T

    NEW CHARACTER SET HAS BEEN BUILT.

    SYM MAP? (ENTER "A" FOR ASSISTANCE)

? H

                    TOTAL DENSITY HISTOGRAM

                      1            21563
                      2            27890
                      3              875
                      4              360
                      5              136
                      6             1628
                      7             6683
                      9             8030
```

10	10879
11	1693
12	2462
13	13997
14	9206
62	46
63	8952

SYM MAP?

? Y

MAP HAS BEEN SENT TO MAIN SITE: ENJOY THE WALK!

PROXIMITY GENERATION

A. Discussion

The TELEPRO system does not have the capability to produce a literal visual representation of the home range of an animal from the statistical output of TELEPRO.TRIAN. The closest approximation to a visual representation of home range that a user of TELEPRO can generate is what is known as a proximity. Generating a proximity produces a variable in which concentric circles, within a user-specified range, are drawn around a given point or line. The user specifies the range in number of database cells away from the given point. If the data base being used contained cells representing 1 hectare each, a proximity range of 12 would fill in all the area around a point within a radius of 12 hectares. In deciding what range to specify, the user should consider — based on his own personal knowledge and on the home range statistics produced by TELEPRO.TRIAN -- how mobile he feels the animal to be. The more mobile the animal is, the higher the range should be. The combination of all the radii generated around all the locational points for a given animal will produce a fairly close approximation of the actual home range of that animal.

Referring to the Sample Session, the two arguments specified on the @CARTER*TELEPRO.PROX,T statement are (1) the current cycle of the database, and (2) the old cycle of the database that will become the new current cycle after the proximity update. The response to "HOW MANY VARIABLES WILL THERE BE AFTER OUTPUT?" should be the ((number of variables currently in the database) + 1). "WHAT VARIABLE WILL BE USED FOR OUTPUT?" should be responded to with the next available variable in

the database (the same as the response to the previous question). The response to "WHAT VARIABLE IS THE PROXIMITY CONCERNED WITH?" should be the sequence number of the variable in the data base that contains the locational data from which you wish to produce the proximity. For the purposes of TELEPRO users, the query "ENTER THE NUMBER OF SUBCLASSES YOU ARE CONCERNED WITH THEN THE SUBCLASS NUMBER.", should be responded to with a -1.

The Sample Session provided will create a proximity and add it to the data base. In order to produce a character-map of the proximity, you should refer to the section entitled MAPPING DATA BASE VARIABLES.

B. Sample Session

(User inputs are underlined. Machine responses are indented and machine prompts are indicated by ?.)

```
? @CARTER*TELEPRO.PROX,T    NOXUBEE.,NOXUBEE2.

     HOW MANY VARIABLES WILL THERE BE AFTER OUTPUT?

? 12

     WHAT VARIABLE WILL BE USED FOR OUTPUT?

? 12

     WHAT VARIABLE IS THE PROXIMITY CONCERNED WITH?

? 10

     WHAT IS THE RANGE FOR THIS PROXIMITY?

? 12

     ENTER THE NUMBER OF SUBCLASSES YOU ARE CONCERNED WITH THEN THE
     SUBCLASS NUMBERS. (IF YOU WANT ALL SUBCLASSES EXCEPT 0 ENTER -1
     FOR NUMBER OF SUBCLASSES)

? -1

     DATABASE HAS BEEN READ IN

     PROXIMITIES CALCULATED

     DATABASE UPDATED -- NORMAL TERMINATION
```

GENERATING CROSSTABS

A. Discussion

Cross tabulations may be computed between two variables in the data base. A cross tabulation is a comparison by subclass of two variables. The concept can be thought of as if one variable were being "laid on top of" another variable to determine the number of cells of each subclass in variable A that fall on each subclass in variable B. The output from a crosstab is a table such as the one shown in the Sample Session. Variable 6 is an animal location variable. It contains only two subclass values — subclass value 1 (indicating everywhere the animal was located) and subclass value 0 (indicating everywhere the animal was not located). Variable 1 is the land cover variable with its fifteen landcover types. Refer to line 14 in the table. This line would be interpreted as follows: There were 16 different cells of land cover type 1 in which the animal was located. The next line indicates that there were 12 cells of land cover type 2 in which the animal was located. The user will probably not be interested in where the animal was not located, so the lines in the table with a 0 under the heading VAR-6 may be disregarded.